

# AirCasting Youth Workshop

*Empowering Youth and Communities to Clear the Air  
and Improve Public Health*



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# Introduction

Welcome to the [AirCasting Youth Workshop](#)! In this workshop, you will learn about air quality, both in your neighborhood and around the world. You'll have a chance to take your own air quality measurements, analyze your data, and find out what steps you can take to improve your air and your health.

By the end of today's workshop, you will understand

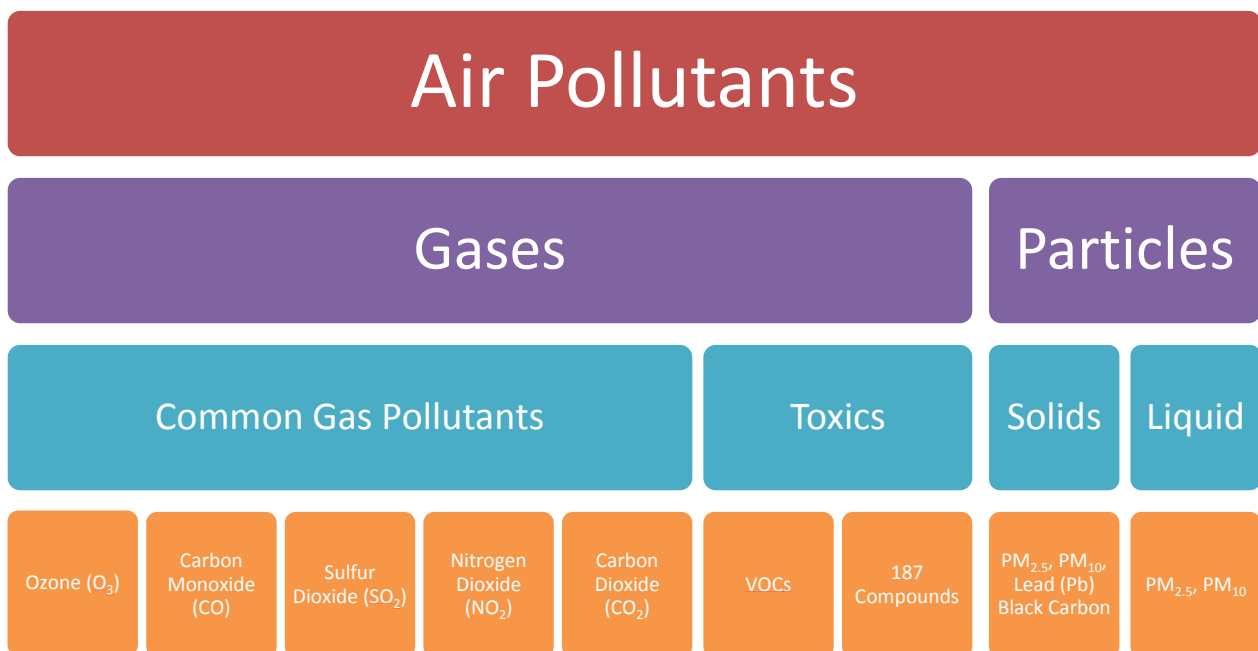
- What particle pollution is, where it comes from, and how it affects human health.
- How to use air quality sensors to measure particle pollution by measuring the amount of light scattered.
- How to use the AirCasting platform and your own observations to identify sources of particle pollution, collect air quality measurements, and make sense of the data.
- How to employ best practices to collect quality data with a high degree of accuracy.
- How to evaluate and select the most appropriate method to better understand your data.

# What's in Our Air?

Do you know what's in the air you're breathing? Most of it is good for us, but some of it doesn't belong there!

Air is made up of

- A mixture of invisible gases, particles, and water
- Mostly nitrogen (78%) and oxygen (21%)
- Other elements, such as
  - Water vapor
  - Particulate matter
  - Carbon dioxide
  - Ozone
  - Argon



# What Is a Particle?

Okay, so we know particles are in our air. But what are they made of? How big are they?

A particle

- Is a complex mixture of extremely small solid and liquid components.
- May contain many different materials, such as combustion products, organic compounds, dust, pollen, etc.
- Can be both a primary and secondary pollutant. A primary pollutant is emitted directly from a source, while a secondary pollutant forms through reactions with other substances.
- Often varies tremendously in size. Today we'll focus on fine particulate matter (PM<sub>2.5</sub>) and coarse particulate matter (PM<sub>10</sub>).
- May form in the air in many different physical and chemical ways.

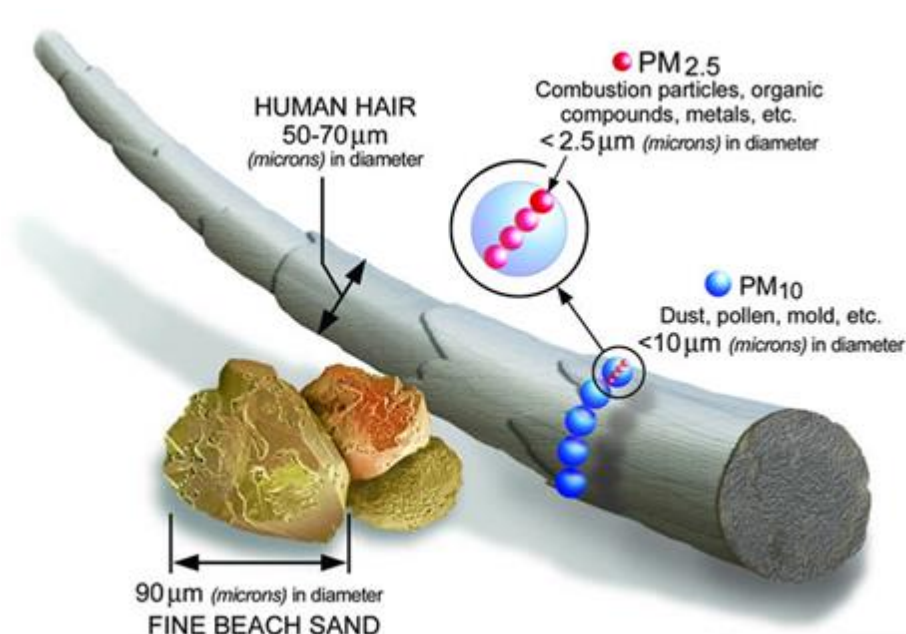


Image courtesy of the U.S. Environmental Protection Agency.

# Where Do Particles Come From?

Particles get into our air in many different ways. Here are some of the most common sources of air pollution:

- **Combustion**
  - Natural: Forest fires, plant emissions
  - Manufactured: Wood-burning stoves, cars and trucks, power plants
- **Evaporation**
  - Natural: Oil, gas, and plant emissions
  - Manufactured: Industrial chemicals, oils, and gases
- **Weather**
  - Dust, volcanoes, drought-enhanced forest fires

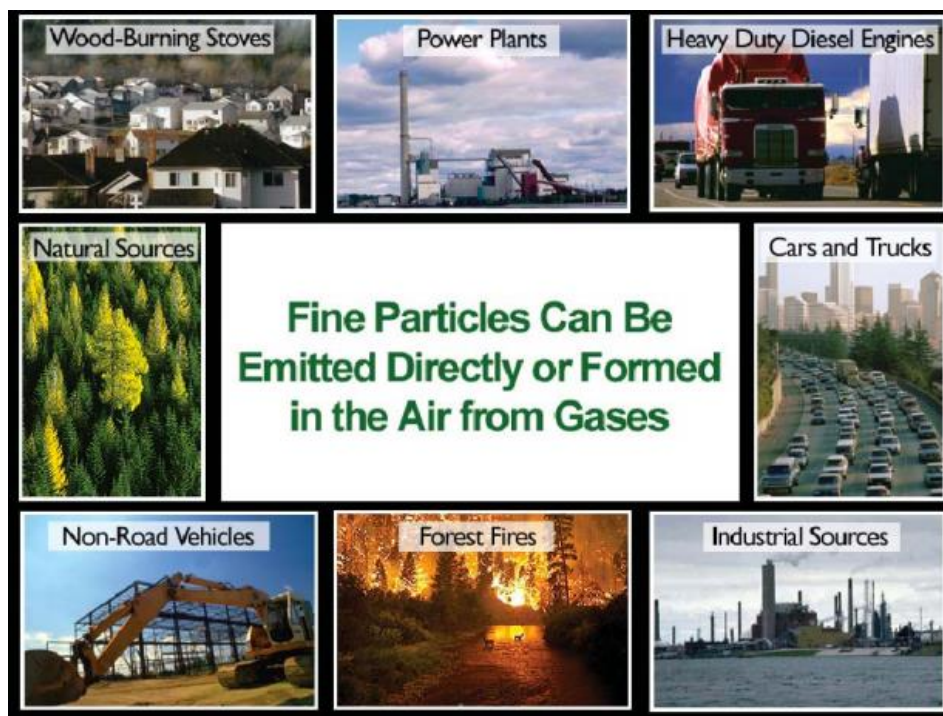


Image courtesy of the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.

## How Long Do Particles Stay in the Air?

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We know how particles enter our air, but how long do they stay?

- Gravity pulls big particles down out of the air faster than smaller particles. When these particles settle on a surface, it is called [sedimentation](#).
- Many small particles stay suspended for hours.

The table below outlines the residence time (how long particles stay in the air) for 3 different sizes of particles.

Particle Size	Residence Time
Ultrafine	Days to a week
Fine (PM <sub>2.5</sub> )	Weeks to a month
Coarse (PM <sub>10</sub> )	Hours to a day

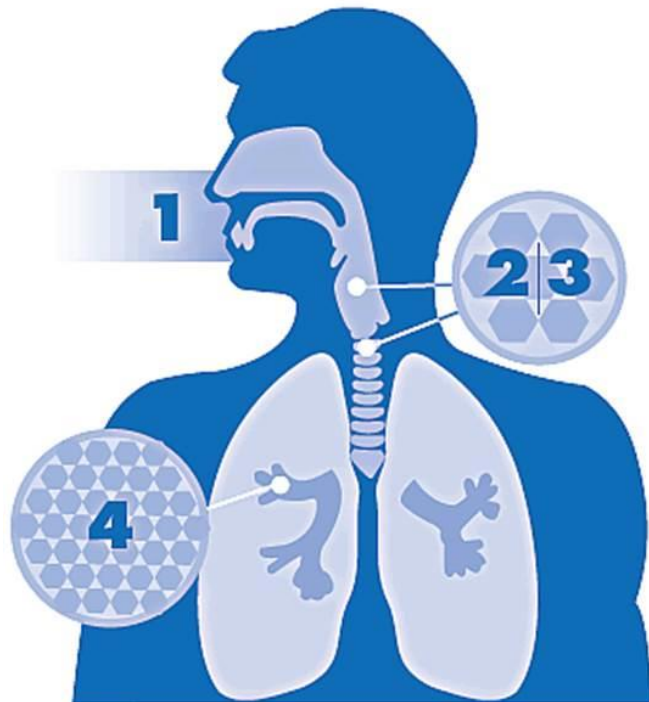
# Why Do Particles Matter?

Now you know more about particles than you ever thought you would. But why should you care? As it turns out, particles can affect our bodies and our environment in some pretty serious ways.

When you breathe in, fine particles can travel deep into your lungs, causing

- **Respiratory problems**, such as coughing, throat irritation, difficulty breathing, asthma, bronchitis, and many other ailments. Some of these problems are short-term, and others may become chronic with prolonged exposure.
- **Heart problems**, such as heart attacks or an irregular heartbeat.

## How Particulate Matter Enters the Body



- 1 Particulate matter enters our respiratory (lung) system through the nose and throat.
- 2/3 The larger particulate matter ( $PM_{10}$ ) is eliminated through coughing, sneezing, and swallowing.
- 4  $PM_{2.5}$  can penetrate deep into the lungs. It can travel all the way to the alveoli, causing lung and heart problems, and delivering harmful chemicals to the blood system.

Image courtesy British Columbia Air Quality,  
<http://www.bcairquality.ca/health/air-quality-and-health.html>.

## Did you know?

- People who live or work in buildings within 100 meters of a major roadway are at a significantly increased risk for asthma and cardiovascular disease.
- 50-70% of particles emitted by fires in home fireplaces reenter the home.



# How Do AirCasting Sensors Work?

There are many different types of sensors and instruments that measure particles in the air. We'll use the AirCasting system, which contains a particle-counting sensor. Let's take a closer look at the sensor and learn how it works.

In a light-scattering sensor

- Light is absorbed and scattered by particles.
- Light scattering is related to the amount of fine particles in the air.
- The intensity of light received by the detector depends on
  - Amount of particles
  - Size of particles
  - Wavelength of light
  - Angle of light scattering
  - Number of particles
  - Color of particles

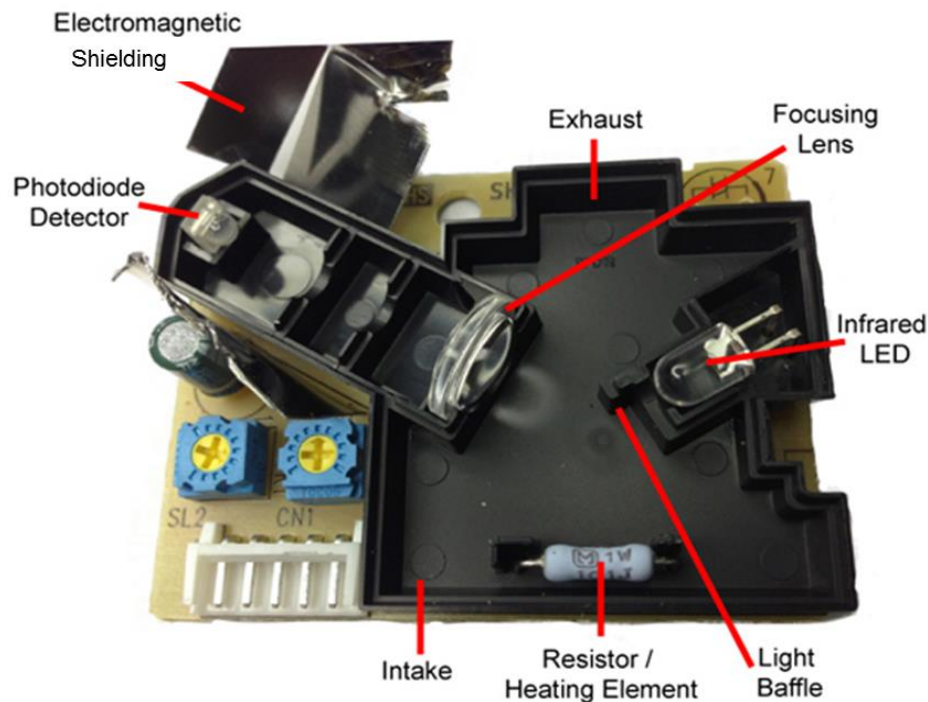


Image by Chris Nafas, modified by HabitatMap.

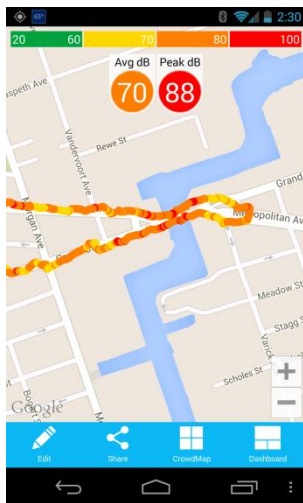
## Exercise

Now let's take apart a sensor and see how it works.

# Using the AirCasting App

## Sensors Dashboard

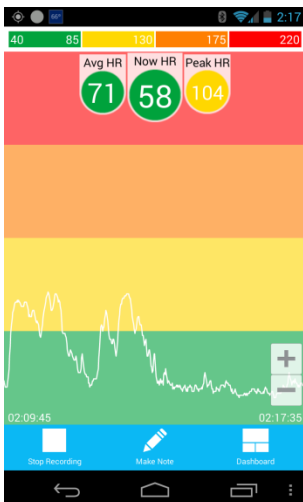
On the **Sensors Dashboard**, tap sensor tiles once to hide/show the peak and average values for your session, and tap tiles twice to pause the stream. To map or graph a sensor stream, long press the tile, then drag and drop it on the *Map* or *Graph* areas at the top of the screen. Sensor tiles can also be rearranged using the long press, drag and drop method.



## Map

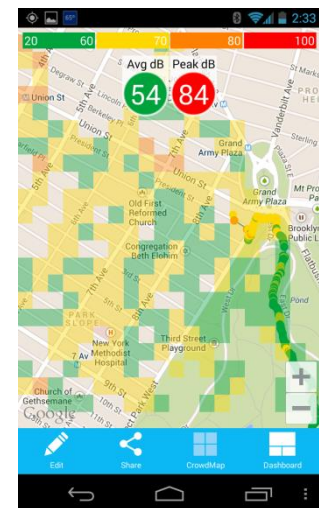
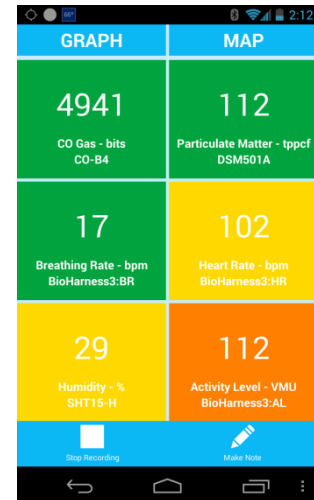
The **Map** shows your current position by a colored dot with a white outline. Dots without an outline are prior readings. A dot's color illustrates the intensity of a reading – see the *Heat Legend* (the colored bar at the top of the screen) to check the intensity range for a given reading. For example, a sound level reading shown by a yellow dot means the intensity of the sound recorded is between 61 and 70 decibels. To toggle between sensor streams without returning to the Sensors Dashboard, tap the *Avg*, *Now*, or *Peak* circles at the top of the screen.

From the Map screen, you can view AirCasting data from all contributors by pressing the *CrowdMap* button. The color of each square shows the average intensity of all the readings recorded in that area. See the *Heat Legend* to check the intensity range for a given square. For example, a sound level reading shown by an orange square means the average intensity of the sound recorded in that area is between 71 and 80 decibels. If no colors are displayed, there are no data in that area.



## Graph

The **Graph** displays your readings over time. Zoom in and out for more or less detail and swipe to pan through the data.



## Begin AirCasting

To begin AirCasting:

1. Make sure your GPS is on (you'll see your location on the map).
2. Press the *Center Map* button in the app to refresh your location and center the map.
3. Verify that your location is accurate and press the *Start Recording* button to begin a new AirCasting session.

*Note: A GPS fix is necessary for you to map your session or contribute your data to the CrowdMap.*

To stop AirCasting:

1. Press the *Stop Recording* button to close out your session.
2. Enter a title, tags, and description and press *Save Session*.

# Plan Your AirCasting Route

You are all particle experts now! It's time to take a closer look at YOUR air. What are you breathing right now? Before we go out and explore the neighborhood, let's think about where particle levels are likely to be elevated.

Below are some sources of particle pollution. Use this list to decide where you think particle pollution concentrations will be lowest and highest, and explain why.

Cars, Trucks, Buses

Residential Boilers

Auto Shops

Construction

Windblown Dust

Factories

Power Plants

Wood Burning

Train Engines

1. Where will particle pollution be lowest? Why? Mark this location on the map provided.
2. Where will particle pollution be highest? Why? Mark this location on the map provided.
3. Using the map provided, draw a walking route that connects your school to the location where you think particle pollution will be highest. Next, connect your school to the location where you think particle pollution will be lowest. *Your route should be relatively direct and require less than 1 hour to walk roundtrip.*

# Let's Go AirCasting

It's time for you to put your air quality knowledge into action. You'll take a walk around the neighborhood and measure particles in the air today. Let's take a few minutes to divide into groups and assign each group member a role.

## Assign Roles

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1. Divide into small groups and come up with a one-word name for your group.
2. Each person in your group will have a specific role while AirCasting. As a group, decide who is going to perform which role. You will have the same role for the entire AirCasting session.

### Air Monitor Transporter

You are responsible for carrying the monitor and making sure the group collects quality data.

- Identify the air intake and exhaust fan—make sure they are not covered up as you carry the device.

### Phone Carrier and Time Keeper

You are responsible for operating the AirCasting app, noting elevated measurements, and keeping track of the time.

- Check the phone every few minutes to make sure the session is being recorded. Stay within 10 feet of the monitor to maintain the Bluetooth connection.
- Note elevated measurements using the *Make Note* button. Take a photo of your surroundings if you like.
- When you stop the session, tag it with your school name and your group name (group name must be one word).
- Keep track of the time and make sure everyone in your group returns to school on time.



### Observer and Cartographer

You are responsible for identifying pollution sources and making notes for mapping later. Bring a clipboard or other hard surface to write on.

- When you encounter a pollution source, mark your position on the map with an "X." Draw a straight line from the "X" to the pollution source and label the source (for example, idling truck, road construction).

## Identify Sources and Record Your Findings

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As you walk your AirCasting route, examine your surroundings to identify and record sources of air pollution.

Use your senses to observe your surroundings:

- What direction is the wind coming from? Is the wind calm, moderate, or strong?
- How close is the potential emission source?
- How do your readings change over time?
- What potential sources do you see, smell, or hear?

Keep a record of what you experience:

- Take pictures with the Android phone and save them in the AirCasting app.
- Record notes in the AirCasting app and/or on paper.
- Mark sources on your map.

## Connect the AirBeam Sensor to AirCasting

Connect the AirCasting app to the AirBeam sensor by following these steps:

1. Turn on the AirBeam. You'll know it's on when the red LED indicator begins blinking.
2. Press the menu button, then press *Settings*.
3. Press *External devices*, then select the AirBeam from the list of paired devices. When prompted to connect, press *Yes*. You will then be redirected to the Sensors Dashboard.
4. In 5-20 seconds, measurements from the AirBeam will appear on the screen and the blinking red light on the AirBeam will switch to solid red. You're connected!

## View AirCasting Data

AirCasting offers 3 ways to view your sensor data:

3. Sensors Dashboard (default view)
4. Map
5. Graph



# Process and Interpret Your Data

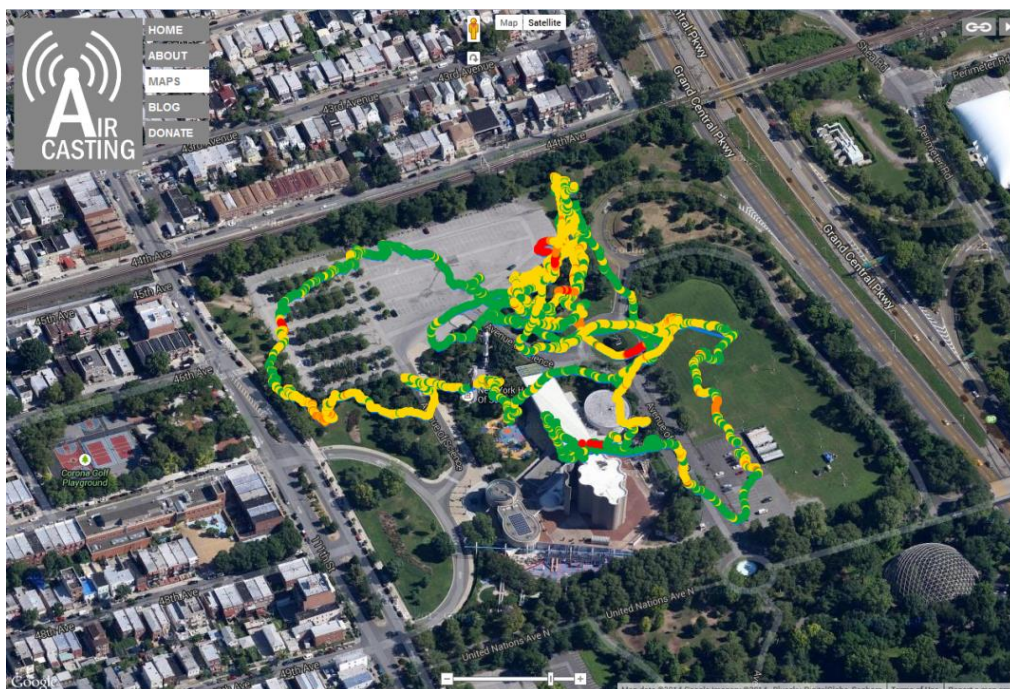
Congratulations on completing your first AirCasting session! As a group, take a look at your data (we'll help you with this part) and tell us what you did and what you learned.

After we download and view your data, spend about 20 minutes analyzing the data and discussing your AirCasting session with your group. Take notes, because you'll be sharing your observations and results with the class afterward. Here are some questions to help guide your discussion:

- Were the measurements what you were expecting?
- Where were particle levels highest? Lowest? Why?
- Did any readings surprise you? Why?
- How do you think the time of day, day of the week, and season may have affected your measurements?
- Were particle sources the ones you were expecting?

Now your group will have 5 minutes to report on what you found. Here are some ideas to help you along:

- Where did you go?
- What did you find?
- What did you learn?
- How would you change what you did?



# Thank You

Thank you for AirCasting and for your interest and participation in the AirCasting Youth Workshop! We are constantly working to improve our tools for educators, students, and community activists. If you have suggestions or would simply like to share your experience, please contact us at [contact@kidsmakingsense.org](mailto:contact@kidsmakingsense.org) and visit us at [kidsmakingsense.org](http://kidsmakingsense.org).



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